



Onsite Wastewater Treatment Systems Technology Fact Sheet 13

Renovation/Restoration of Subsurface Wastewater Infiltration Systems (SWIS)

Although an analysis to diagnose problems in OWTs is provided in chapter 5, this Fact Sheet is included to provide a special reference to identify alternatives likely to be recommended to renovate and restore SWIS and observed results.

Functions of the subsurface wastewater infiltration system (SWIS)

The subsurface wastewater infiltration system (SWIS) receives the effluent pretreated in the septic tank and purifies it through biological, physical, and chemical reactions as it passes through the unsaturated soil to the ground water. An important component of the infiltration system is the biomat, a layer of organic and inorganic material and bacteria that forms at the interface between the trench and the surrounding soil. The biomat enhances treatment efficiency because it usually slows down the movement of the effluent, provides the flora and fauna necessary to biologically decompose wastes, and enhances the physical and chemical removal of very small particles of matter in the wastewater. Permeable soil textures and structures are required to support these processes.

SWISs are occasionally unable to accept the total daily wastewater load they receive, leading to ponding and eventual hydraulic failure. This is typically caused by the accumulation of biomass and suspended solids in or near the biomat, which reduces the soil's porosity and hydraulic conductivity. If the system fails hydraulically, the first step is usually to pump the septic tank and clean and replace the effluent screen (also known as a filter).

Restoring the hydraulic function of the infiltration system involves eliminating or reducing the flow restrictions. Various methods and products have been developed for restoring the infiltration capacity of SWISs. These include resting, additives, hydrogen peroxide, and soil fracturing.

A variety of additives are also marketed to improve the performance of septic tanks or eliminate the need for pumping. These septic tank additives are discussed in Special Issue Fact Sheet 1.

SWIS restoration alternatives

Periodic resting

Periodic resting is a passive method for restoring the hydraulic capacity of the SWIS. Infiltration surfaces are "rested" by removing them from service for an extended period of time, typically 6 to 12 months. To remove a portion of the SWIS from service requires that the SWIS be constructed with multiple cells that have a total hydraulic capacity of 100 to 200 percent of the design flow, or enough suitable reserve SWIS area. Resting may also be used in seasonal facilities that discharge no wastewater for extended periods of the year. The portion of the SWIS taken offline receives no wastewater during the resting period, which allows the infiltration surface to drain and dry out. The resulting aerobic biochemical oxidation of the biomat mass can restore the porosity of the biomat, helping to unclog the system.

Several studies have shown resting to be an effective method to rejuvenate the hydraulic capacity of soil infiltration surfaces (Sharpe et al., 1984). Extended periods of resting at regular intervals is effective in preventing excessive soil clogging and restoring clogged infiltration surfaces. Seventy to eighty percent of the original infiltration capacity of the soil can be recovered by resting. The rate of restoration is proportional to grain size; that is, sand restores more quickly than silt and clay.

Some studies have explored the potential for adding earthworms when a malfunctioning SWIS is pumped. Generally, this approach has not been successful. If the system is basically sound in design, loaded within design limits, and located in well-drained soils, some improvement in hydraulic function may occur when worms are used, especially if some water conservation measures are implemented. However, no quantitative data exist to support the concept that worms aid SWIS restoration.

Additives

In addition to the additives described in Special Issue Fact Sheet 1, there are commercially available compounds that are apparently benign to the treatment processes in the septic tank and have potential benefit to the SWIS by exchanging with potentially harmful ions (e.g., sodium), that could destroy existing fine soil structure. Such additives could be useful in places having high-sodium drinking water or in areas with hard water supplies where ion exchange softeners are used and the regenerant is not discharged to the SWIS, leaving those soils with an excess of sodium ions. In general, however, the benefits of SWIS additives are not well documented. Chemical additives that contain strong acids or bases or toxic chemicals are generally discouraged or banned because of the possible adverse effects these chemical can have on system components, the soil structure, or ground water quality. Biological additives, on the other hand, may have some small benefits, but there is little published documentation to support this view. Microbial and enzyme preparations appear to enhance liquefaction of biodegradable solids in septic tanks. However, the effects of their use on the soil infiltration surface have not been documented. Studies have shown that biological additives are not directly harmful to traditional onsite systems, but significant beneficial impacts have not been documented with domestic wastewaters (Clark, 1999).

Hydrogen peroxide

Hydrogen peroxide (H_2O_2) is a chemical treatment that was once promoted for its ability to treat a clogged SWIS. H_2O_2 , a strong oxidant, was pumped directly into the absorption trench to restore the hydraulic capacity of the infiltration zone by oxidizing the biomat and breaking down the crust surrounding it. While early research on the use of hydrogen peroxide to unclog SWIS in sandy, unstructured soils appeared positive, subsequent testing did not. Controlled field studies found decreasing infiltration rates for clogged systems treated with H_2O_2 . These reports suggest that hydrogen peroxide mobilizes fine soil particles during initial treatment in some soils. As the chemical reactions subside, however, these fine particles are deposited on top of the infiltrative surface, which can result in further clogging. Hydrogen peroxide can produce temporary benefits at a substantial cost, and is not recommended for regular long-term use in unclogging failed drainfields.

Hydrogen peroxide is a strong oxidant that has been shown to be very effective in eliminating biomats in SWIS, but it can also reduce soil porosity and hydraulic conductivity. The process has been shown to oxidize or “boil” the soil, which creates a layer of fine particles that are released when the soil peds are destroyed on the infiltrative surface. This dramatically reduces the hydraulic capacity of SWIS.

Pneumatic soil fracturing

Pneumatic soil fracturing is a mechanical treatment used to increase soil porosity by fracturing and lifting the soil surrounding the infiltration surface. A steel probe, inserted below the infiltration surface, is used to inject high-pressure air into the soil. The air fractures and lifts the ground. As the soil expands, polystyrene beads are discharged into the soil fractures, thereby holding them open to increase the porosity of the soil after the particles settle. However, any hydraulic improvements are accompanied by a potential for contamination of underlying aquifers. Insufficient data are available to recommend use of this concept in any area where sensitive ground water supplies lie in close proximity to the infiltrative surface.

Introduced in the early 1990s, pneumatic soil fracturing is a relatively new treatment method. Thus, available performance data on the method are limited and incomplete. Appropriate applications and expected performance are unknown.

Application

These renovation methods can be applied for either preventive maintenance or rehabilitation after a hydraulic failure has occurred. Resting and the application of additives are primarily preventive maintenance methods. Standby infiltration cells to allow resting can be constructed with the original system or additional land can be held for replacement if failure of the original infiltration system fails. It should be noted that the ability to alternate cells regularly during normal operation is more effective as a preventive maintenance technique than a method to relieve a failed system. The use of additives and hydrogen peroxide is generally not recommended.

Users must be aware that when any of these methods are used to correct hydraulic failures, only the symptoms of failure is treated. The causes of the failure will usually persist. Therefore, the causes of failure should be identified and appropriate corrective action taken to prevent recurrences. Excessive daily flows, inadequate or improperly maintained pretreatment processes (e.g., failure to pump septic tank), and changes in wastewater characteristics because of new ownership or changes in use are common causes of hydraulic failure. If these failures are not eliminated or accommodated through appropriate system modifications, the effectiveness of the treatments will be short-lived.

Responsibilities of the homeowner

The key responsibilities of the homeowner in ensuring the best operation of an existing or new septic tank/SWIS system include the following:

- *Using household cleansers in moderation.* Excessive use of household cleansers, disinfectants, and other common products can kill bacteria residing in the septic tank and the soil adsorption field. Used in moderate amounts and according to label directions, however, cleaners and disinfectants can be flushed into the wastewater system with no significant impacts. The wastewater stream dilutes the product, and organic material adsorbs it. Slug loading (excessive, instantaneous loadings) of household cleaners can be lethal to septic system bacteria, but normal follow-up usage usually reestablishes the tank's bacterial population within a few hours.
- *Avoiding disposal of toxic and hazardous materials in the wastewater stream.* Many common household products have toxic properties and should never be poured down the drain. The list includes drugs and antibiotics, solvents, paints, varnishes, photography chemicals, weed killers, and insecticides. All of these products have the potential to wipe out septic system bacteria and percolate into ground water supplies.
- *Curbing the use of drain cleaners and openers.* Products aimed at unclogging indoor wastewater pipes contain strong acids or alkalis as the active ingredient. Used according to the label directions, they can be effective in removing clogs of organic matter in indoor drainpipes. Most product labels warn, however, that the product is caustic or corrosive to pipes and can be hazardous to the user if applied improperly. A controlled study concluded that as little as 1.3 ounces of a name brand drain cleaner could destroy the bacteria population in a 1,000-gallon septic tank. This amount is within the general range of normal usage for some people. Bacteria populations in the tank will recover in a few days if the system inputs return to normal levels.
- *Disposing of solids appropriately.* Items such as cigarette butts, condoms, sanitary napkins, paper towels, and kitty litter should never be flushed or washed down the toilet or sink. Septic tanks are not designed as a disposal receptacle for these wastes. They can clog drainpipes and cause excessive and rapid sludge buildup in the tank.
- *Keeping fats, oils, and grease out of kitchen drains.* Fats, oils, and grease are natural by-products of cooking meats and other foods. Grease washed down the drain can stick, accumulate, and in some cases block wastewater drain pipes and the inlet and outlet structures in septic tanks. Food wastes should be scraped from plates and utensils and discarded as solid waste.

- *Avoiding the use of a garbage disposal unless the treatment system is designed for one.* Homes with garbage disposals generally have 20 to 28 percent higher biochemical oxygen demand (BOD) and 25 to 40 percent higher suspended solid loadings to septic tanks than homes without disposals. These significant contributions of organic matter require special consideration when sizing and installing a septic tank or soil absorption system.
- *Conserving water.* To function at peak efficiency, the septic tank needs to provide a quiescent environment and adequate detention time (i.e., more than 24 hours) for the solids and floatable matter to separate from the wastewater. Limiting water flows and timely repair of leaking fixtures help maintain these conditions and prevent overloading of the soil adsorption field.

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